



## Pathology/Biology Section - 2015

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### H40 A Re-Examination of Patterns of Abuse in Children

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After attending this presentation, attendees will recognize the importance of anthropological skeletal analysis in pediatric cases and the recognition of fracture patterns associated with Non-Accidental Injuries (NAI) in children, including spiral fractures in long bones.

This presentation will impact the forensic science community by supporting the need for the combination of forensic pathology with trauma anthropologists during autopsy, expanding the definition of injuries associated with NAI, and reinforcing the need for a comprehensive understanding of bone biomechanics and the total trauma pattern.

The recent inclusion of in-house forensic anthropologists in medical examiners' and coroners' offices has evolved trauma anthropology. Trauma anthropologists use their training in human skeletal anatomy, biomechanics, and trauma interpretation in fresh autopsies to recognize and decipher the patterns associated with fracturing, allowing for a complete view of injury patterns. In pediatric cases, trauma anthropologists have revealed fracture patterns associated with NAI that may be overlooked in digital images and the forensic pediatric autopsy. Examination of the underlying bone by a trauma anthropologist is a key component to fully illustrating all injuries in pediatric cases. Fracture patterns associated with NAI include Classic Metaphyseal Lesions (CML), posterior rib fractures, complex skull fractures, and multiple fractures of varying ages.<sup>1,2</sup> Spiral fractures are not accidental as some research suggests, rather they may be non-accidental patterns in all cases, and especially in non-weight bearing bones and when the child is not independently mobile.<sup>3</sup>

Biomechanical interpretations reveal how bone behaves as a material as well as to how bones behave in life; factors vital in understanding skeletal injuries.<sup>4</sup> Spiral fractures specifically are a result of torsional forces acting in tension and shear on the movable (non-stable) end of the bone. Understanding biomechanics, fracture production, and directionality of fracturing allows for the anthropologist and the pathologist to understand events surrounding and leading to death.

A case of a four-month-old male is presented as an example of trauma anthropology contributions to autopsy findings. The case originally came to the medical examiner's office as an infant found unresponsive in his crib. The pathologist found multiple acute posterior rib fractures at autopsy and requested an anthropological examination of the injured ribs and all long bones to examine for CMLs. The anthropologist observed the previously noted posterior rib fractures, but also discovered undiagnosed injuries including sternal rib end fractures, evidence of healing rib trauma, and two acute spiral fractures to long bones. The latter injuries contributed to the pathologist's findings by providing a better understanding of a pattern of non-accidental inflicted trauma. The pair of spiral fractures in long bones represent severe and duplicated trauma to an infant and the healing rib fracture establishes a pattern of abuse. These findings are "enablers" for a child abuse investigation, scrutiny of caregivers, and eventual prosecution in cases of demonstrated abusive behavior. While everyone wants to believe the caregivers' story in a child death case, a total body trauma examination may substantiate or change an accidental death to a suspicious death or homicide. In this case, an immediate confrontation with caregivers culminated in a full confession of the mother, with specific accounts of the lethal event.

This presentation will discuss the biomechanics behind the creation of NAI and, in particular, spiral fractures and their omissions in literature as patterns associated with NAI in children. Obviously, the team approach between coroners, forensic pathologists, and trauma anthropologists is suggested in order to diagnose injuries that may be overlooked when a skeletal survey is not routinely conducted on infant deaths.



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## References:

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  3. Campbell RM, Schrader T. Child Abuse. In: Beaty JH, Kasser JR, editors. *Rockwood and Wilkins' Fractures in Children*, 6th Edition. Philadelphia, PA: Lippincott Williams & Wilkins, 2006: 223-253.
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## Trauma Anthropology, Spiral Fractures, Non-Accidental Injuries